

***Cambarus (Jugicambarus) jezerinaci* (Crustacea: Decapoda:  
Cambaridae), a new species of crayfish from the Powell River  
Drainage of Tennessee and Virginia**

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*Abstract.*—A new species of crayfish, *Cambarus (Jugicambarus) jezerinaci*, is described from first and second order, spring fed streams draining into the Powell River in Tennessee and Virginia. It is believed to be a sister species of *Cambarus (Jugicambarus) parvoculus* and differs in having thickened rostral margins abruptly angled at the cephalic terminus (90°) to form an acumen, a smaller body size, reduced dorsal and ventral ridging of the chelate fingers, reduced lateral impression of chela, immovable finger having four enlarged tubercles (second from base largest), a propodus equal in length to the palm length, and an oval-shaped chela outline.

While evaluating the taxonomic status of *Cambarus (Cambarus) bartonii cavatus* Hay, 1902, the type locality ("Powell River, Tazewell, Tennessee" Hay 1902:435) was visited in an effort to obtain topotypic material of *C. (C.) b. cavatus*. Unable to locate any crayfish that resembled my concept of *C. (C.) b. cavatus* in the Powell River, I began searching smaller and smaller streams in the vicinity of Tazewell, Tennessee. Suspecting that Hay may have obtained his type material while cave exploring, on 18 August 1978, I visited Cave Spring, where a small stream debouches from a cave northeast of Tazewell, Tennessee into Mill Hollow. No specimens resembling *C. (C.) b. cavatus* were found but numerous small, blue or red, sexually mature crayfish of the subgenus *Jugicambarus* Hobbs, 1969 were collected which proved to represent a new species described herein. Other crayfishes of the genus *Cambarus* collected in the area were a species of the subgenus *Puncticambarus* Hobbs, 1969 that has previously been referred to as Species D (Hobbs 1969), and *Cambarus (Cambarus) angularis* Hobbs & Bouchard, 1994.

Material used in this description has been deposited in the Ohio State University Museum of Biological Diversity Crustacean Collection (OSUMC), the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM) and the Cleveland Museum of Natural History (CMNH). Adobe Photoshop 2.5.1 LE<sup>®</sup> was used to produce computer enhanced photographic illustrations. Systat 5.2.1<sup>®</sup> was used for regression analysis.

*Cambarus (Jugicambarus) jezerinaci*, new species

Fig. 1, Table 1

*Diagnosis.*—Body pigmented. Eyes small. Carapace subcylindrical, slightly dorsoventrally flattened. Rostrum with straight, slightly convergent margins, thickened, without marginal spines or tubercles, abruptly curved cephalically, terminating in upturned corneous acumen. Areola 2.7–5.5 ( $\bar{X} = 4.2$ ,  $n = 69$ ) times longer than wide, comprising 33–37% ( $\bar{X} = 35\%$ ,  $n = 69$ ) of total length of carapace, bearing 1 to 5 punctuations across narrowest part ( $\bar{X} = 3$ ,  $n = 69$ ). Cervical spine and tubercle absent.

Cervical groove continuous or interrupted. Suborbital angle acute, with blunt spine. Postorbital ridge without cephalic spine or tubercle. Branchiostegal spine reduced to small knob. Antennal scale approximately 2.3 times as long as broad, usually broadest at base; distomesial margin strongly converging on lateral margin to form spine on distal end. Basipodite and ischium of antenna lacking spine. Chela lacking tubercles on dorsal and ventral surfaces, length 75% (71–81%) of total carapace length in Form I males ( $n = 9$ ), 66–81%,  $\bar{X} = 74\%$  in females ( $n = 50$ ), 1 row of 5–8 ( $\bar{X} = 6$ ,  $n = 69$ ) cristiform tubercles along mesial margin of palm and dorsopalmar furrow running from median dactyl articulation to mesial side of propodus articulation with carpus. Lateral margin of propodus smooth, not impressed at dorsal or ventral surface; longitudinal ridges on finger of dorsal propodus moderately developed, weakly developed on dactyl; dactyl 1.2–1.6 ( $\bar{X} = 1.4$ ,  $n = 69$ ) times longer than mesial margin of palm; palm width 40–52% ( $\bar{X} = 46\%$ ,  $n = 69$ ) of chela length; palm length 70–93% ( $\bar{X} = 84\%$ ,  $n = 69$ ) of chela width; row of 4 enlarged tubercles on opposable margin of propodus finger, second tubercle from base largest; opposable margin of dactyl with row of 3 enlarged tubercles, middle tubercle smallest; lacking subpalmar tubercles; lacking cluster of elongated setae at base of propodus finger. Dorsomesial margin of carpus of chela with 1 distal spine and 1 proximal blunt tubercle; ventral surface with 1 conical tubercle, occasionally none. Ventrolateral ridge of merus usually with 2 or 3 spines. Copulatory hook only on ischium of third pereopod of male. Boss on ischium of fourth pereopod well developed. First pleopods of Form I male contiguous at base, with 2 short terminal elements bent at angle greater than  $90^\circ$  to main shaft; corneous central projection truncated distally, bearing conspicuous subapical notch; mesial process inflated, tapering distally; Form II male pleopods non-corneous, terminal elements more bulbous than Form

I male and bent at angle greater than  $90^\circ$  to main shaft. Females with annulus ventralis deeply embedded in sternum, asymmetrical and having a rounded diamond shaped outline, slightly movable, without cephalolateral prominence.

*Holotypic male, Form I.*—Body subovate (Fig. 1E), dorsoventrally compressed. Abdomen narrower than cephalothorax (12.3 and 14.9 mm respectively); maximum width of carapace greater than depth at caudodorsal margin of cervical groove (14.9 and 10.4 mm respectively). Areola broad with 3 rows of punctations in narrowest part; 4.2 times longer than wide; length comprising 35.4% of total length of carapace. Rostrum with slightly convergent, thickened, raised margins; rostral margins curved ventrally starting at postorbital ridges; acumen distinctly delimited basally, anterior tip upturned and corneous, reaching base of penultimate podomere of antennular peduncle; dorsal surface of rostrum concave with sparse punctations. Postorbital ridges weak, grooved dorsolaterally, and ending cephalically without spines or corneous tubercles. Suborbital angles prominent; branchiostegal spines absent. Cervical spines represented by small knob. Hepatic and branchiostegal regions granulate. Remainder of carapace punctate dorsally and granulate laterally. Abdomen subequal in length to carapace, pleura short, subtruncate, rounded caudoventrally. Cephalic section of telson with 2 spines on each caudolateral corner. Proximal podomere of right uropod with 9 distal spines on mesial lobe; mesial ramus of uropod with prominent median rib ending distally in small distomedian spine not overreaching margin of ramus, distolateral spine of ramus also strong.

Cephalomedian lobe of epistome (Fig. 1H) short and subpentagonal having angular bends at median margins, ventral surface rather flat; main body with shallow central fovea; epistomal zygoma strongly arched. Ventral surface of proximal podomere of antennular peduncle without acute spine at base of distal third. Antennal peduncle

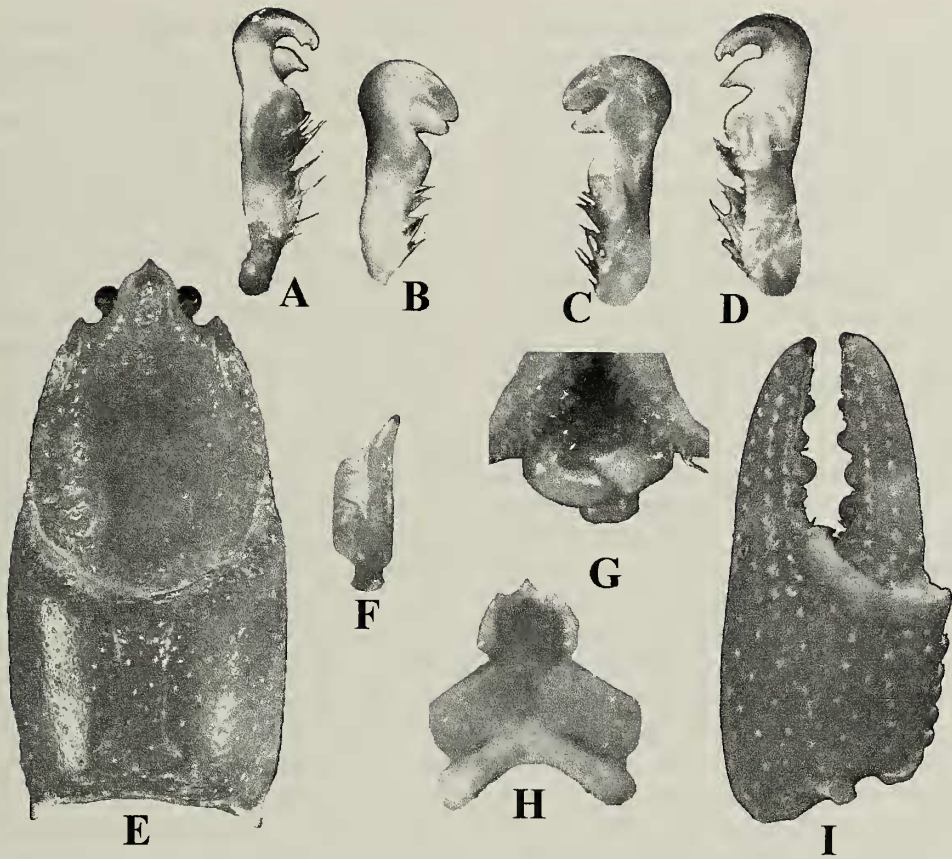


Fig. 1. *Cambarus (Jugicambarus) jezerinaci*, new species: (all from holotype male, Form I (OSUMC 3614), except B and C from morphotype male, Form II (OSUMC 3616), and G from allotype female (OSUMC 3615)) A, B, lateral view of male first pleopod; C, D, mesial view of male first pleopod; E, dorsal view of carapace; F, dorsal view of antennal scale; G, annulus ventralis; H, epistome; I, dorsal view of left cheliped.

without spines; antennal scale (Fig. 1F) 2.5 times as long as broad, broadest at mid-length, mesial margin forming gentle arc; distal spine strong, reaching base of distal extremity of antennular peduncle. Ventral surface of ischium of third maxilliped with evenly spaced rows of tufts of long, flexible setae; submarginal lateral row of seta on podomere small and flexible; distolateral angle not acute; mesial margin with row of teeth alternating large and small, teeth larger distally.

Length of left chela (Fig. 1I) 78% that of carapace (right chela regenerated); width 45.5% of length; palm length 45.5% of chela length; dactyl length 1.3 times palm length. Dorsomesial surface of palm lack-

ing tubercles, mesial margin with row of 6 cristiform tubercles, dorsal surface slightly punctate, punctations very small; lateral surface of palm and fixed finger of propodus not costate; ventral surface of palm less punctate than dorsal, lacking corneous tubercles on articular rim opposite base of dactyl; no subpalmar tubercle. Opposable margin of fixed finger of propodus with row of 5 tubercles (third from base largest) along proximal 66% of finger; single row of denticles between fourth and fifth tubercle, double row of denticles extending distally from fifth tubercle. Opposable margin of dactyl with row of 4 tubercles, (first and third from base larger than second and fourth) along proximal 75%; single row of



denticles between third and fourth tubercle, double row of denticles extending distally from fourth tubercle. Dorsomedian longitudinal ridges on both fingers weakly developed, none expressed ventrally. No dorsolateral impression at base of fixed finger.

Carpus of cheliped with distinct sinuous furrow dorsally; dorsomesial and lateral surfaces smooth; mesial surface with 1 large spiniform tubercle and 2 additional small ones; ventral surface lacking tubercles. Merus with 2 slightly developed pre-marginal dorsal tubercles, ventrolateral row of 3 spiniform tubercles, and ventromesal row of 7 spiniform tubercles, decreasing in size proximally; podomere otherwise smooth. Ventral ridge of ischium with 2 spiniform tubercles.

Ischium of third pereopod with simple hook extending proximally over basioischial articulation, not opposed by tubercles on basis. Coxa of fourth pereopod with vertically disposed caudomesial boss; that of fifth pereopod lacking boss, its ventral membrane bearing oblique rows of small sclerites armed with stiff setae.

First pleopods contiguous at base, reaching coxae of third pereopods; corneous central projection (Fig. 1A, D) bent caudally at angle greater than  $90^\circ$ , tapering distally, with subapical notch and not extending beyond mesial process; mesial process subconical and directed caudolaterally (left more so); lacking caudal knob.

*Allotypic female*.—Ovigerous. Excluding secondary sexual characteristics, differing from holotype in following respects: areola length 36.2% of total length of carapace and 3.8 times longer than wide; antennal scale 2.4 times as long as broad, widest at base; right chela 74.7% of carapace length, palm width 40.2% of chela length; opposable margin of dactyl with row of 5 tubercles (4 left), second tubercle from base largest; merus with ventrolateral row of 3 tubercles, and ventromesial row of 9.

Annulus ventralis (Fig. 1G) deeply embedded in V-shaped sternum, asymmetrical and having a rounded diamond shaped out-

line, with a narrow sinuous fossa beginning just behind anterior edge and intersecting sinus at posterior margin near midline; tongue extending caudosinistrally in fossa, disappearing beneath thickened caudosinistral wall; sinus reverse S-shaped and ending under caudal wall slightly dextral to median line. Postannular sclerite oval. First pleopods damaged.

*Morphotypic male, Form II*.—Differing from holotype in following respects: areola length 35.1% of carapace length and 3.4 times longer than wide; antennal scale 2.4 times as long as broad; left chela (right regenerated) 75.1% of carapace length; palm length 44.6% of chela length; palm width 44.6% of chela length; opposable margin of fixed finger of propodus with 3 tubercles, second from base enlarged; opposable margin of dactyl with 3 tubercles, first and second from base larger; merus lacking pre-marginal tubercles dorsally, with ventrolateral row of 2 tubercles and ventromesal row of 8; central projection of first pleopod (Fig. 1B, C) non-corneous and blunt.

*Color notes*.—*Cambarus (Jugicambarus) jezerinaci*, new species, exhibits color morphs of red and blue. Red morph individuals grade from a dark brown abdomen to a lighter brown cephalothorax suffused with orange anterior to the cervical groove. Chelae primarily orange mottled with brown, having brown bands on the distal dorsal carpus and merus areas and around the dactyl/propodus joint. Knobs, tubercles, and chela tips orange, the enlarged tubercle of opposable margin of propodus yellow, distal spines of fingers chestnut brown. Merus and distal podomeres of walking legs brown with slight blue tint dorsally and ventrally, orange bands at articulations, podomeres proximal to merus brown dorsally and cream-orange ventrally. Ventral surface of cephalothorax and abdomen white; ventral surface of chela, carpus, and distal merus of first walking legs orange and ventral telson and uropods brown. Eggs of ovigerous females purple. Blue morph individuals concolorous gray-blue dorsally, grad-

ing cream to white ventrally; chela tips cream-orange.

*Types.*—Holotype male Form I, allotype female, and morphotype male Form II: OSUMC 3614, OSUMC 3615, and OSUMC 3616 respectively; Paratypes: USNM 291280 and CMNH 299.

*Type locality.*—Virginia, Lee Co., unnamed tributary of Dry Branch, a tributary of Indian Creek of the Powell River drainage, 0.2 miles (0.32 km) east of Chadwell Gap Trail, 1.4 miles (2.25 km) north of Caylor (36°39'16"N, 83°29'55"W).

*Range and specimens examined.*—*Cambarus (J.) jezerinaci*, new species, appears to have a very restricted range, confined to small tributaries of the Powell River in Lee Co., Virginia and Clairborne Co., Tennessee. Eight lots have been examined: Virginia: Lee Co., 1) OSUMC 3610, type locality (see above), 20 Apr 1986, 36°39'16"N, 83°29'55"W (1♂I, 1♂II, 6♀ ovig.); 2) OSUMC 3608, Hardy Creek adjacent U. S. Rte 58, just downstream of Smiley, 5.0 mi (8.05 km) E of Rose Hill, 20 Apr 1986, 36°41'18"N, 83°17'08"W (1♀ ovig.); 3) OSUMC 3612, trib. Hardy Cr. at culvert on Va. Rt. 790 at intersection of Va. Rt. 658, 3.2 mi (5.15 km) E of Caney Hollow, 20 Apr 1986, 36°40'39"N, 83°15'28"W (2♂I, 6♀ ovig.); 4) OSUMC 3609, large spring trib. to Hardy Cr., 3.7 mi (5.95 km) WNW of Caney Hollow, 1.1 mi (1.77 km) SE of Smiley, 20 Apr 1986, 36°41'05"N, 83°16'13"W (1♂I, 1♂II, 7♀, 1♀ ovig.); Tennessee: Clairborne Co., 5) OSUMC 3611, Mill Hollow tributary (trib.) Powell River, 3.8 mi (6.12 km) ENE of Bacchus, 10.3 mi (16.58 km) SE of Middlesboro, 1 Mar 1984, 36°31'17"N, 83°33'30"W (1♂II, 5♀); 6) Paratypes: CMNH 299 (1♂I, 1♂II, 1I), and USNM 291280 (1♂I, 1♂II, 1♀), Mill Hollow trib. Powell River, 0.75 mi (1.21 km) N of Cave Spring, 4.3 mi (6.92 km) N of Tazewell, 18 Aug 1978, 36°30'56"N, 83°33'15"W; 7) OSUMC 3607, Mill Hollow trib. Powell River, 0.9

mi (1.45 km) N of Cave Spring Church, 4.5 mi (7.24 km) NNE of Tazewell, 13 Aug 1984, 36°30'35"N, 83°33'21"W (4♂II, 8♀); 8) OSUMC 3613, Mill Hollow trib. Powell River, 4.9 mi (7.89 km) NNE of Tazewell, 2.8 mi (4.51 km) NE of Bacchus, 21 Apr 1986, 36°31'44"N, 83°33'41"W (3♂I, 6♀ ovig.).

*Variation.*—Little variation was seen in *Cambarus (Jugicambarus) jezerinaci*, new species. The most noticeable variation was the presence of 1 or 2 spines on the lateral margin of the antennal scale. This character trait occurred in no discernable geographic pattern, though it appeared to occur more often in females.

*Size.*—The largest specimen examined was a female with a carapace length (CL) of 33.8 mm. First form male CL ranged from 28.6 to 16.1 mm. For measurements of types see Table 1.

*Habitat & life history notes.*—Collections have been made in March, April, and August. First form males were observed in April and ovigerous females in April and March. Eight ovigerous females yielded a linear relationship between carapace length and egg number of  $y = -94.1 + 6.3x$  and  $r^2 = 0.78$ , with egg number increasing with carapace length. Other attributes of the life history of this species remain unknown.

This species apparently prefers first and second order, spring feed streams of higher altitude and high gradient. It is a secondary burrower, living under rocks in mid stream and along the stream edges.

*Relationships.*—*Cambarus (Jugicambarus) jezerinaci*, new species, is most similar morphologically to *C. (J.) parvoculus* Hobbs & Shoup, 1947. It may be a sister species of *C. (J.) parvoculus* and could be derived from populations that crossed the drainage divide from the Cumberland River basin to the upper Tennessee and Powell River basins, subsequently becoming isolated. *Cambarus (J.) jezerinaci*, new species, tends to be smaller than *C. (J.) parvoculus* (Male I, carapace length: 21.5 mm vs. 28.5 mm; Male II, carapace length: 21.6

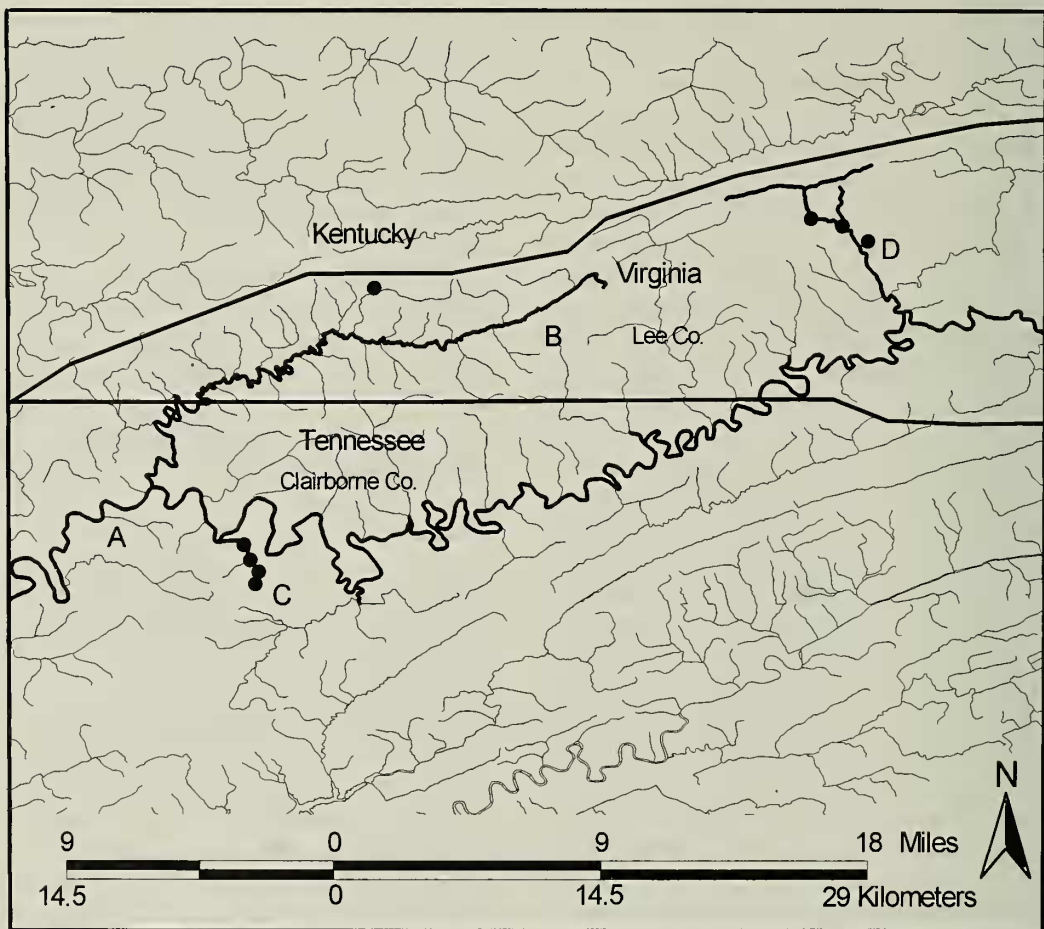


Fig. 2. Distribution of *Cambarus (Jugicambarus) jezerinaci*, new species, in Tennessee and Virginia: A, Powell River; B, Indian Creek; C, Cave Spring; D, Hardy Creek.

mm vs. 25.3 mm; Female, carapace length: 23.2 mm vs. 26.6 mm respectively).

*Comparisons.*—Like all members of the subgenus *Jugicambarus*, *C. (J.) jezerinaci*, new species, can be distinguished from members of other subgenera in *Cambarus* by the presence of a cristiform row of tubercles on the mesial palm of the chela. Within the subgenus *Jugicambarus*, *C. (J.) jezerinaci*, new species, differs from all other species in its unique tuberculation of the opposable margins of the chela fingers. No other species has an enlarged second tubercle on the opposable propodus and enlarged first and third tubercles on the opposable dactyl. The absence of setae on the chela

distinguishes *C. (J.) jezerinaci*, new species, from many members of *Jugicambarus* and the thickened rostral margins abruptly angled at the cephalic terminus ( $90^\circ$ ) to form an acumen, a generally smaller body size, reduced dorsal and ventral ridging of the chelate fingers, reduced lateral impression of the chela, immovable fingers having only four enlarged tubercles, a propodus equal in length to the palm length, and an oval-shaped chela outline also aid in separating *C. (J.) jezerinaci*, new species, from *C. (J.) parvoculus* and other members of the subgenus.

*Crayfish associates.*—*Cambarus (Cambarus) angularis* and a species of *Camba-*



Table 1.—Measurements (mm) of *Cambarus (Jugicambarus) jezerinaci*, new species.

Character	Holotype	Allotype	Morphotype
Carapace			
Height	14.0	16.4	10.2
Width	15.0	17.3	11.4
Length	28.6	33.8	23.2
Areola			
Length	10.1	12.2	8.2
Width	2.4	3.2	2.4
Rostrum			
Width at eyes	3.1	4.0	3.0
Length	4.2	5.0	3.8
Length to anterior postorbital ridges	8.8	9.7	7.2
Distance between postorbital ridges	7.5	8.6	6.0
Chela			
Length	22.2 (left)	25.3 (right)	17.4 (left)
Palm length	9.0	9.0	6.8
Width	10.1	10.2	7.8
Dactyl length	12.1	14.4	10.1
Opposable margin of propodus length	8.4	10.9	7.7
Depth of palm	6.8	6.5	5.2
Abdomen			
Length	29.4	37.3	24.6
Width	12.1	16.3	9.5
First pleopod			
Length	7.2	N/A	5.6
Antennal scale			
Length	4.2	5.2	3.8
Width	1.7	2.2	1.6

*rus* (subgenus *Puncticambarus* referred to as species D (Hobbs 1969)) were collected with *C. (J.) jezerinaci*, new species.

*Etymology*.—It is my belated pleasure to name this species after my dear departed friend and mentor, Raymond Felix Jezerinac. He was a devoted carcinologist and good friend, and is sorely missed. Ray contributed greatly to the understanding of crayfish distributions and evolution in the northern U.S.A. He always had a wry sense of humor and would probably agree that some might say “he lived for better or worse, but he’s dead for good.”

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#### Literature Cited

- Bundy, W. F. 1877. On the Cambari of northern Indiana—Proceedings of the Academy of Natural Sciences of Philadelphia 29:171–174.
- Faxon, W. 1884. Descriptions of new species of *Cambarus*, to which is added a synonymical list of the known species of *Cambarus* and *Astacus*—Proceedings of the American Academy of Arts and Sciences 20:107–158.
- Hay, W. P. 1902. Observations on the crustacean fauna of Nickajack Cave, Tennessee and vicinity—Proceedings of the United States National Museum 25(1292):417–439.

- Hobbs, H. H., Jr. 1969. On the distribution and phylogeny of the crayfish genus *Cambarus*, pp 93–178 in P. C. Holt, R. L. Hoffman, and C. W. Hart, Jr., eds., The distributional history of the biota of the Southern Appalachians, Part I: Invertebrates. Virginian Polytech Institute and State University Blacksburg, Virginia, 295 pp.
- , & R. W. Bouchard. 1994. *Cambarus* (*Cambarus*) *angularis*, a new crayfish (Decapoda, Cambaridae) from the Tennessee River basin of northwestern Tennessee and Virginia—*Jeffersoniana* 5:55–63.
- , & C. S. Shoup. 1947. Two new crayfishes (Decapoda, Astacidae) from the Obey River drainage in Tennessee—*Journal of the Tennessee Academy of Science* 22:138–145.